U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

High Performance Computing for Manufacturing at the U.S. Department of Energy

HPC4Mfg Industry Day
San Diego, CA

March 3rd, 2017

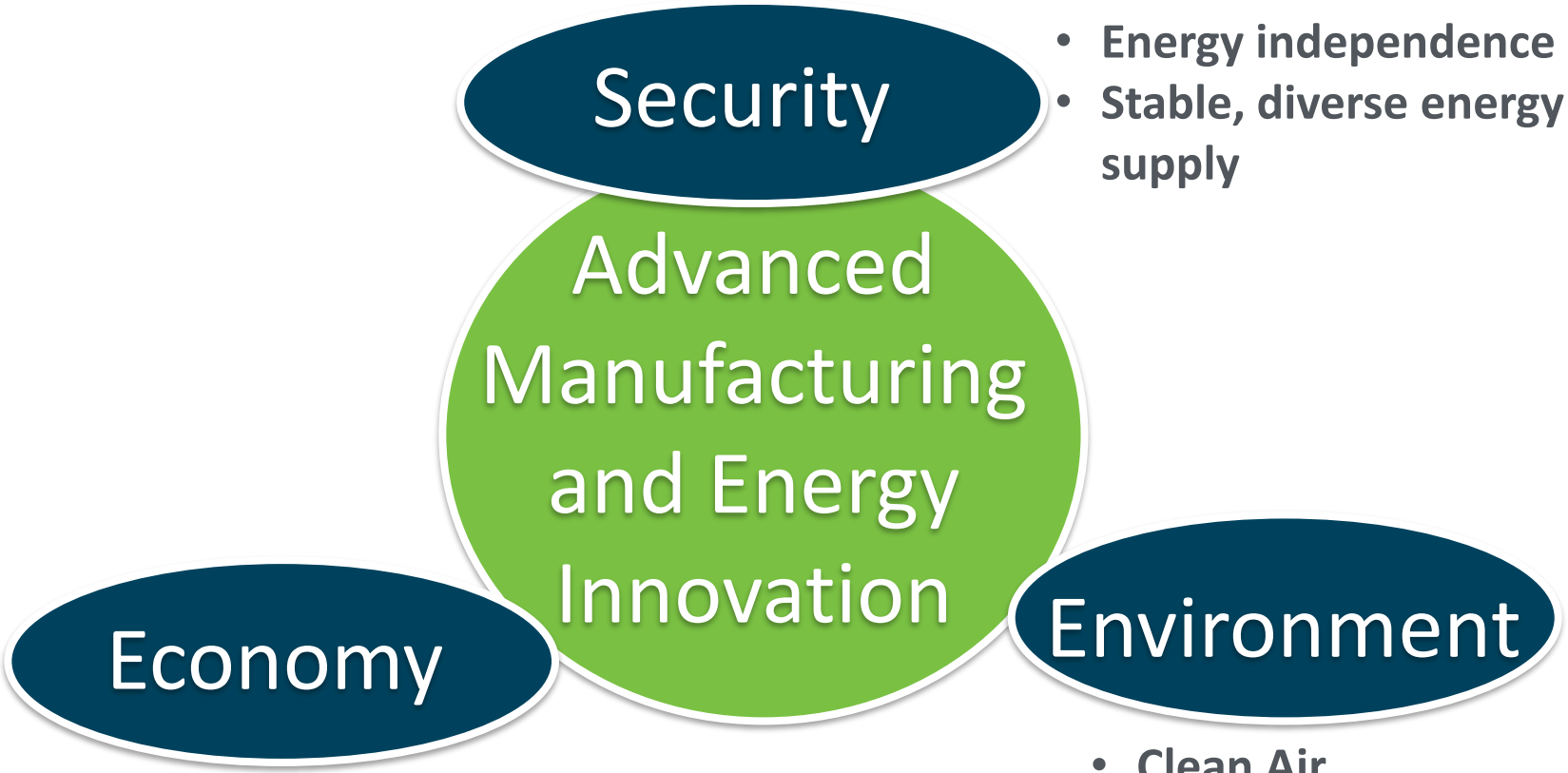
Mark Johnson

Director

Advanced Manufacturing Office

www.manufacturing.energy.gov

Energy and Manufacturing Innovation

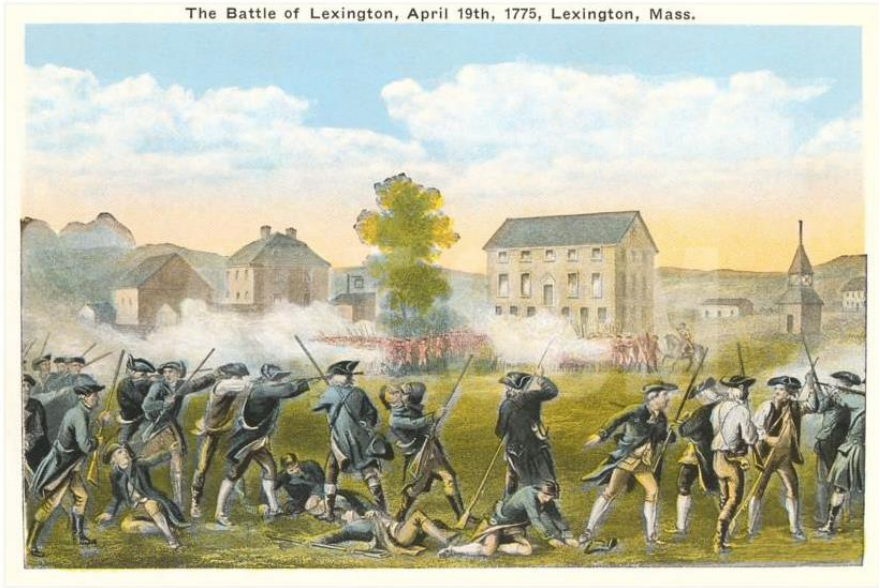


- Energy independence
- Stable, diverse energy supply

- Competitiveness in energy products
- Domestic jobs

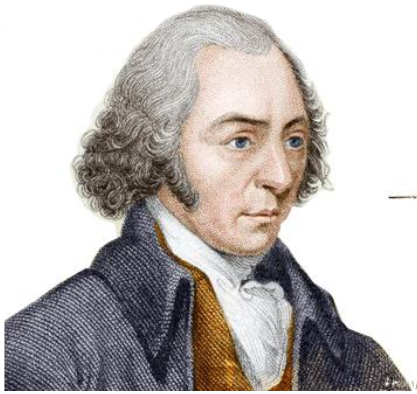
- Clean Air
- Clean Water

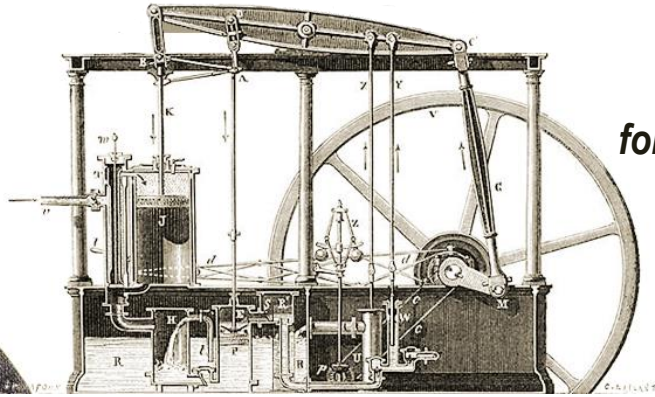
A little history: The Start of a pair of Revolutions



Lexington & Concord

1775



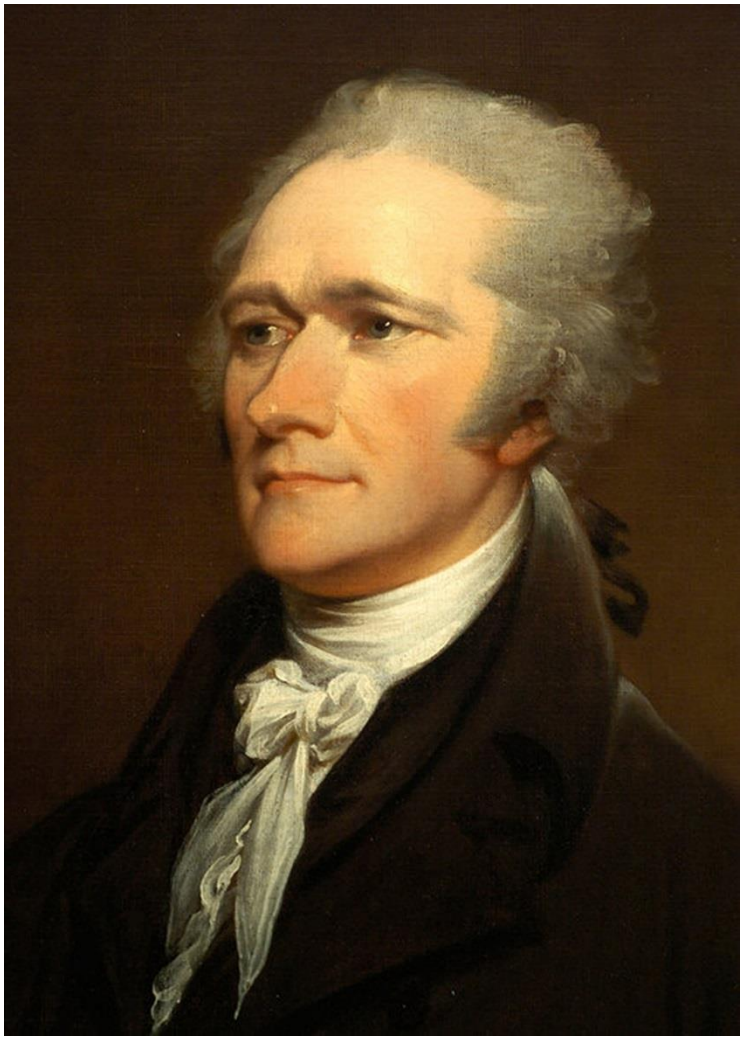


Watt, Boulton & Co.

1775

(intelligence: steam regulation for external combustion engines)

US Manufacturing Strategy for First Industrial Revolution



"… the encouragement of manufactures is the interest of all parts of the Union."

"Not only the wealth; but the independence and security of a country, appear to be materially connected with the prosperity of manufactures."

"… it is the interest of a community with a view to eventual and permanent economy, to encourage the growth of manufactures."

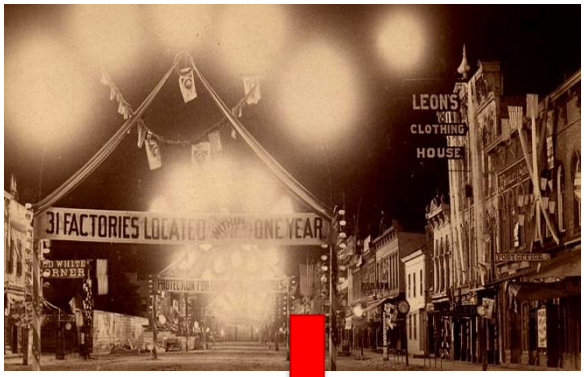
- Alexander Hamilton
US Treasury Secretary (1789-1795)

Reports to Congress

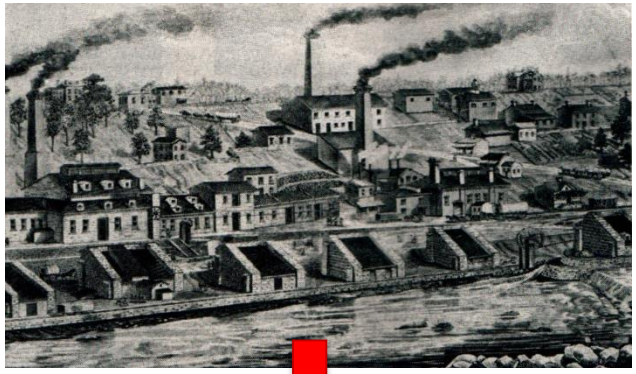
First Report on the Public Credit - 1790
Second Report on Public Credit - 1791
Report on the Subject of Manufactures - 1791

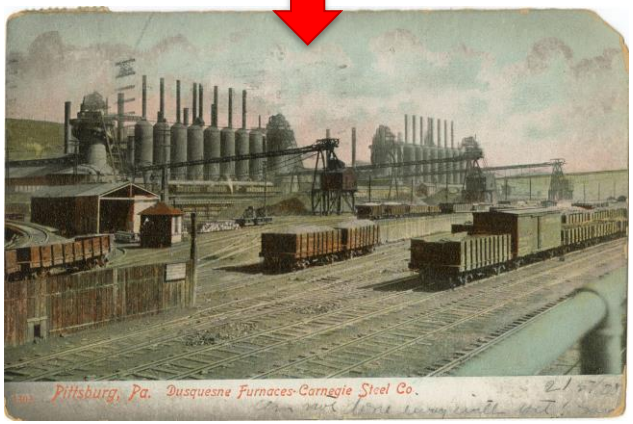
Second Industrial Revolution

Electrification

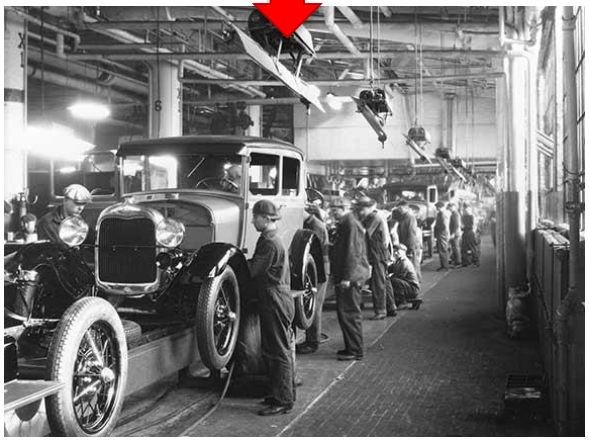


Process Scaling Energy & Materials





Standardization & Assembly Line



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Energy Intensive Industries -Today

Primary Metals
1608 TBTU

Petroleum Refining
6137 TBTU

Chemicals
4995 TBTU

Wood Pulp & Paper
2109 TBTU

Glass & Cement
716 TBTU

Food Processing
1162 TBTU

Other Manufacturing
~1600 TBTU

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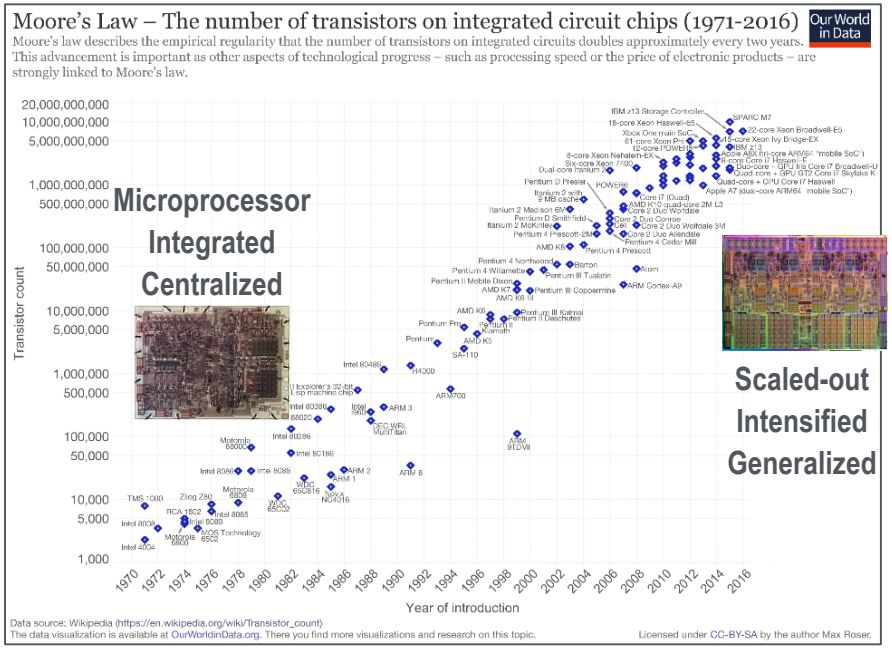
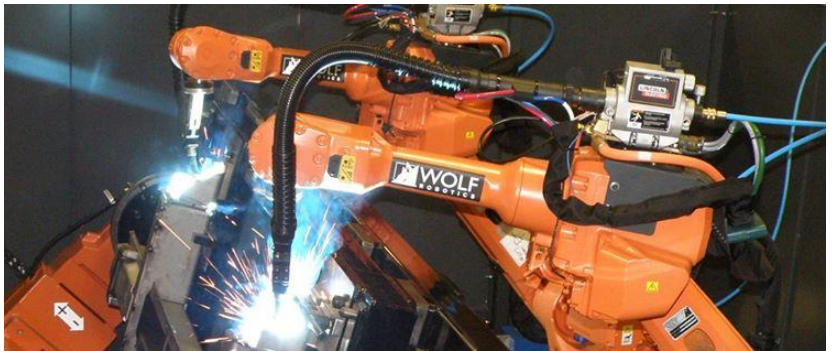
Third Industrial Era





How will Manufacturing, Economy and Security of the Nation depend on Information, Computation, Actuation and Communication Technologies in the 21st Century?

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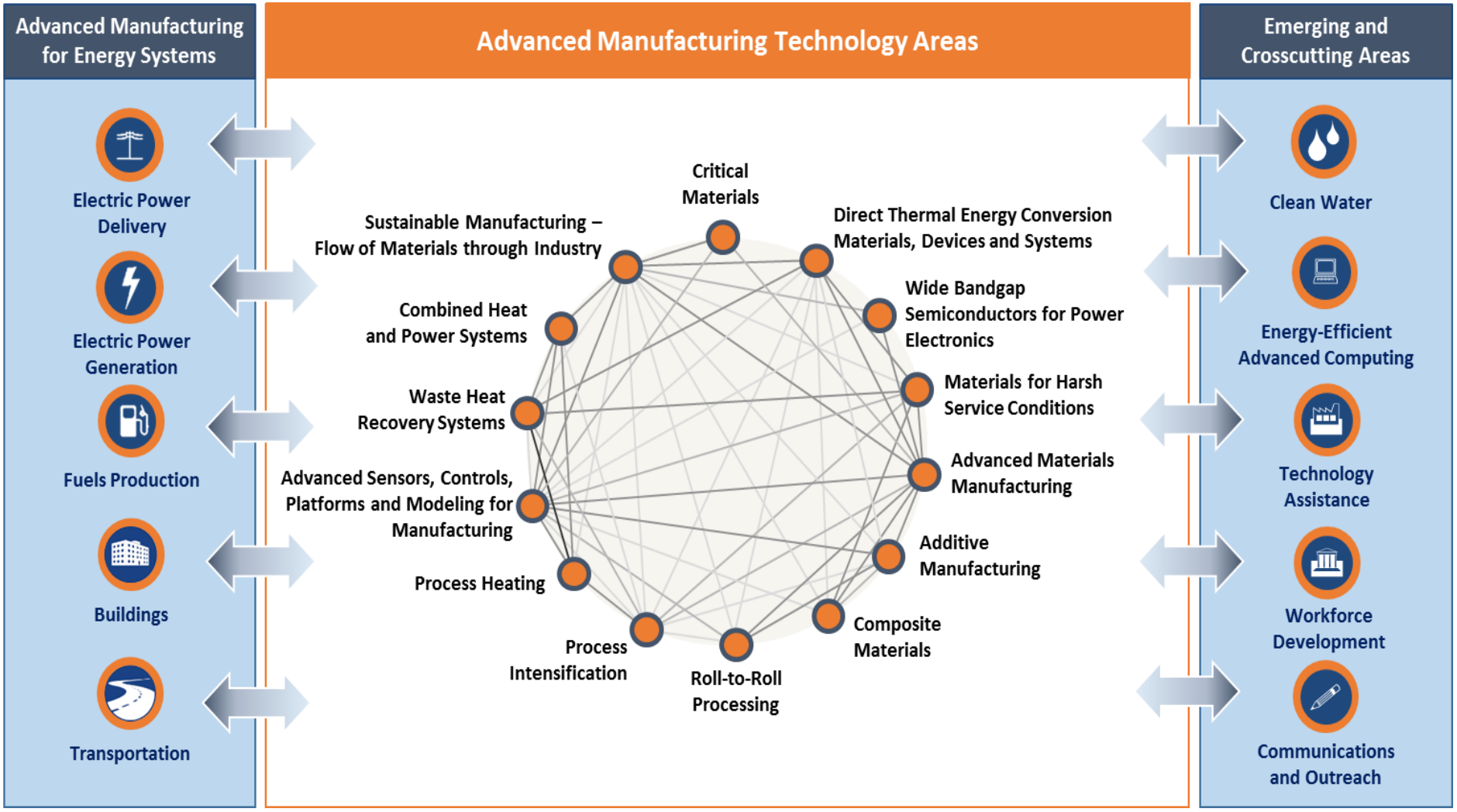
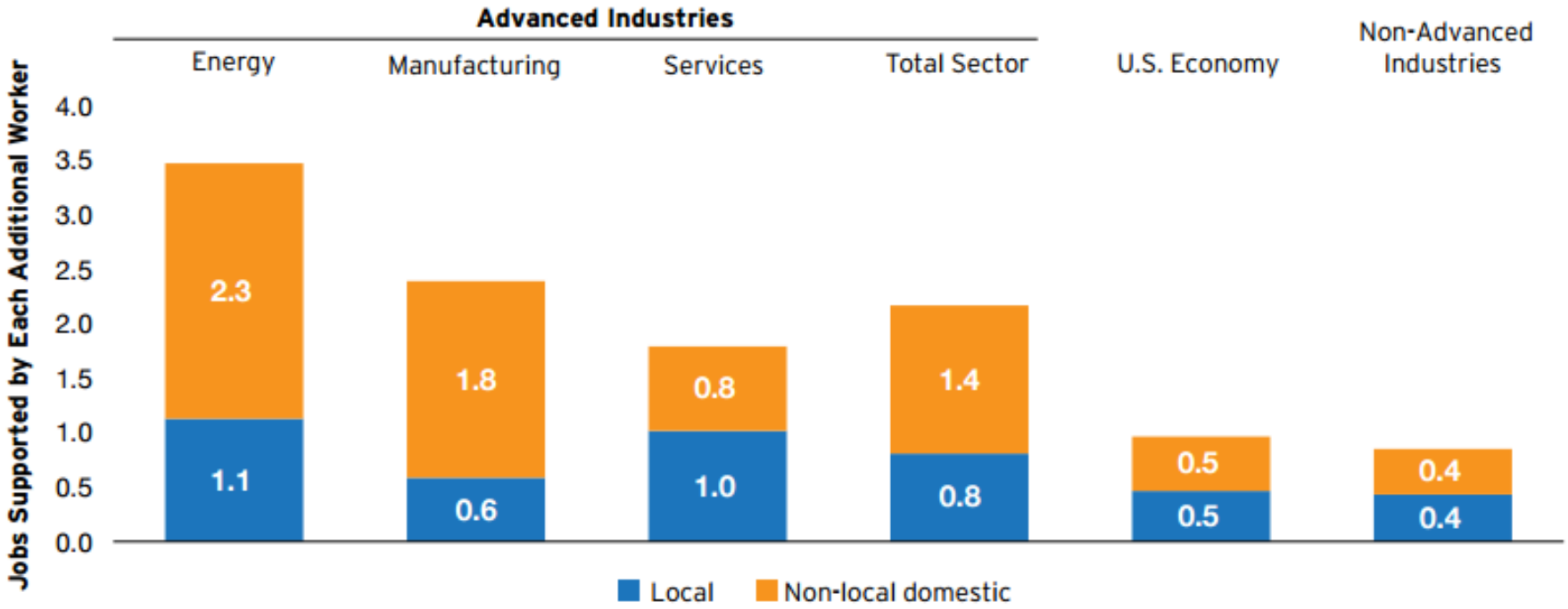
AMO Technical Focus Areas (2015 QTR & 2016 MYPP)



Innovation, Talent and Jobs

Powerful multiplier effects mean every new advanced industry job supports more than two others



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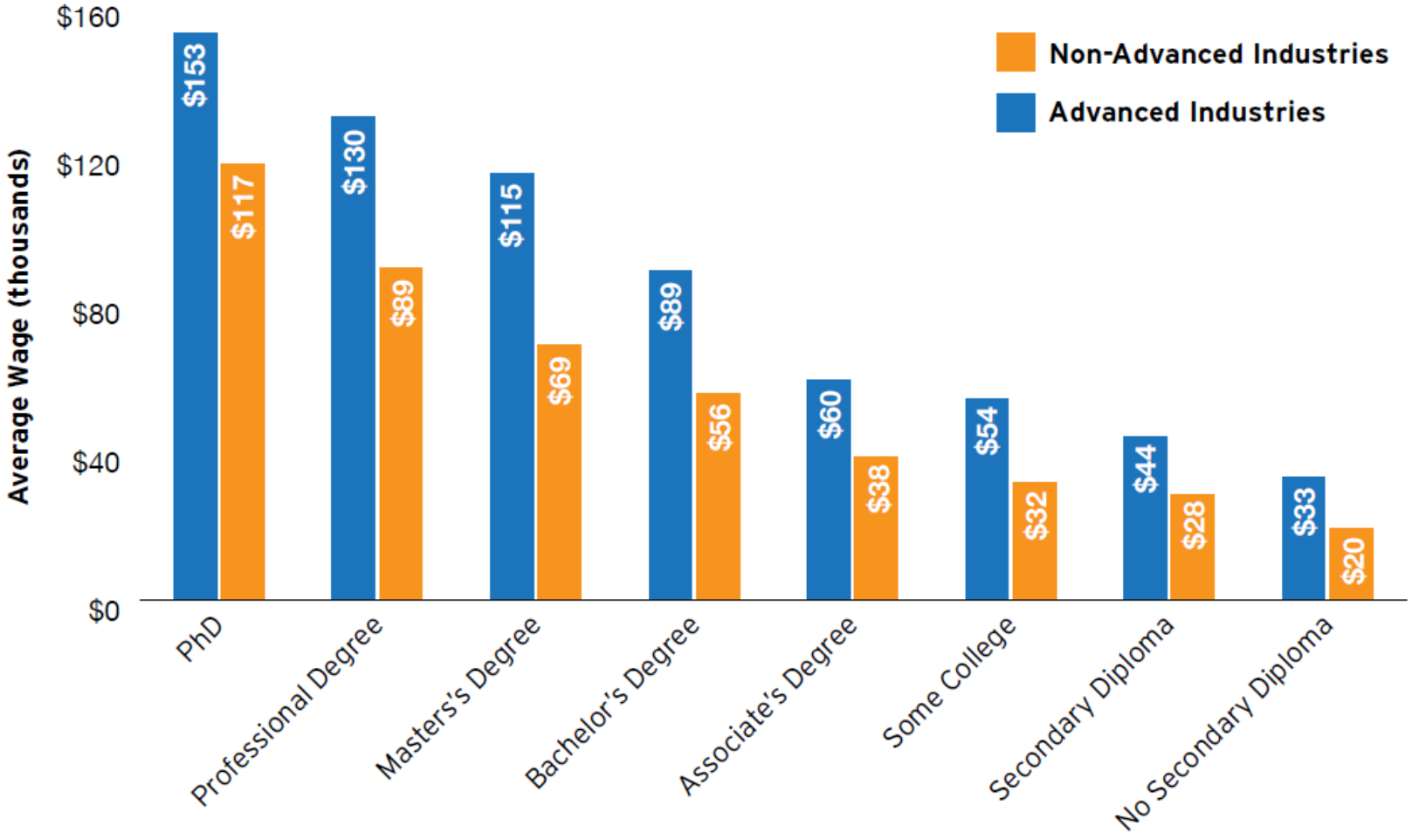
Advanced Manufacturing are Great Jobs!



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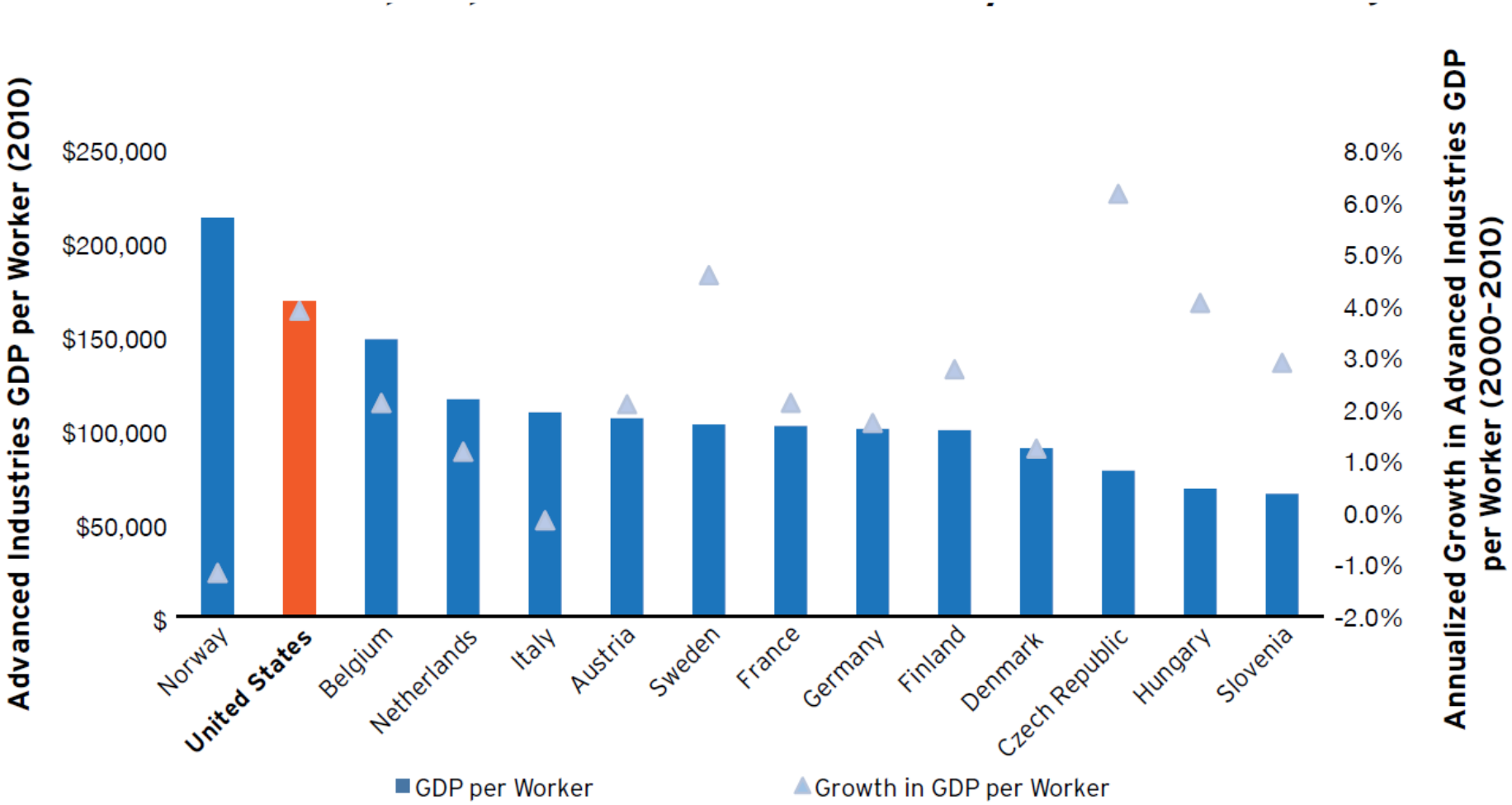
US Workforce is Highly Productive



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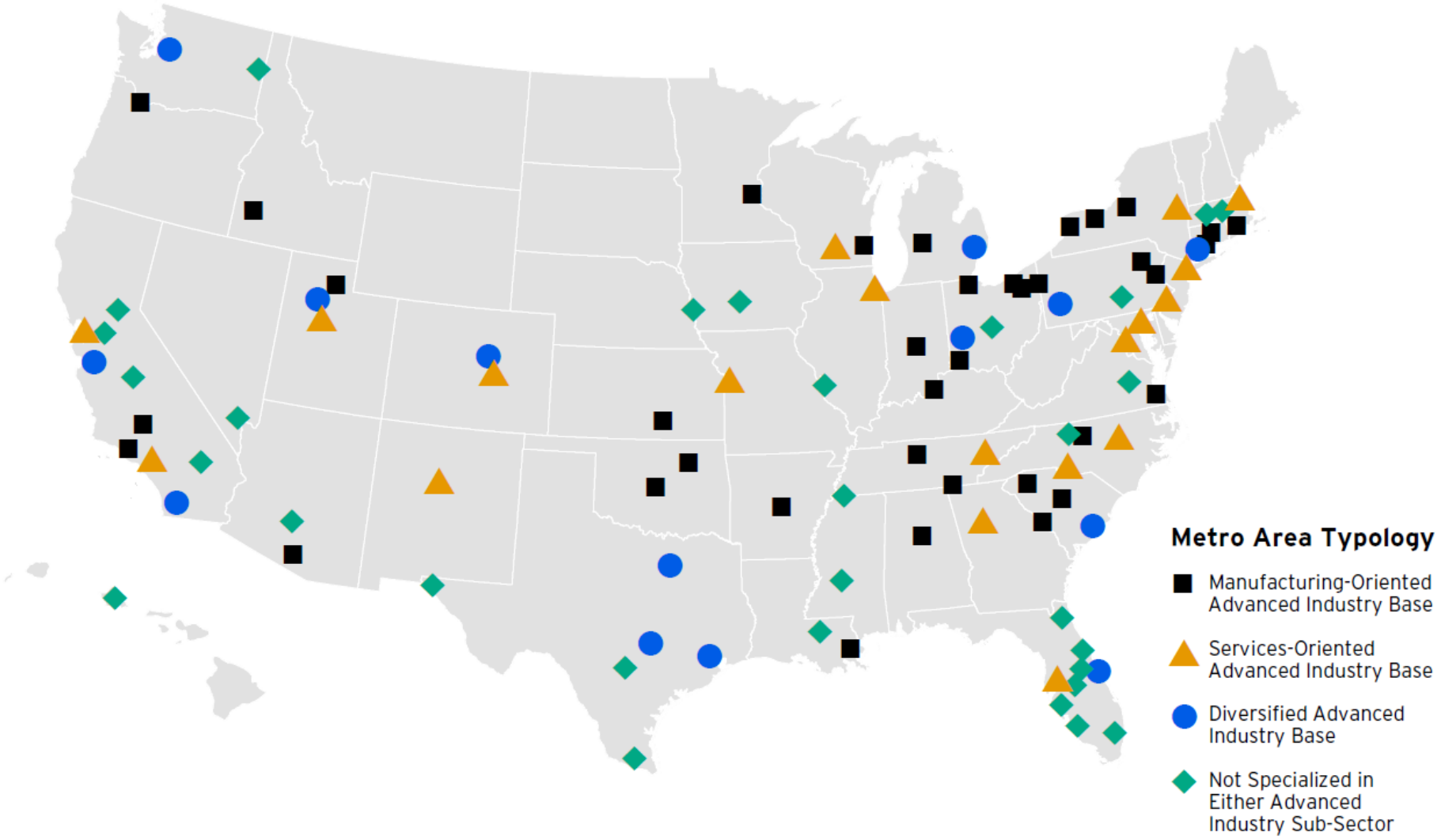
Manufacturing Innovation is Important to the Nation



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AMO: Three complimentary strategies

Technical Assistance: Direct engagement with Industry

Driving a corporate culture of continuous improvement and wide scale adoption of proven technologies, such as CHP, to reduce energy use in the industrial sector

R&D Consortia: Public-Private Partnerships

Shared R&D Facilities offer affordable access to physical and virtual tools, and expertise, to foster innovation and adoption of promising technologies

R&D Projects: Bridging the innovation gap

Research and Development Projects to support innovative manufacturing processes and next-generation materials

CMI Accelerating Energy Innovations

Critical Materials Institute

AN ENERGY INNOVATION HUB

MDF Manufacturing Demonstration Facility

cyclotronroad

INNOVATION CROSSROADS

HPC4 MANUFACTURING

CHAIN REACTION INNOVATIONS

Better Plants®

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THE COMPOSITES iacmi INSTITUTE

CLEAN ENERGY SMART MANUFACTURING INNOVATION INSTITUTE

Superior Energy Performance

U.S. DEPARTMENT OF ENERGY

PowerAmerica

INDUSTRIAL ASSESSMENT CENTERS

Manufacturing USA

RAPID

REMADE INSTITUTE

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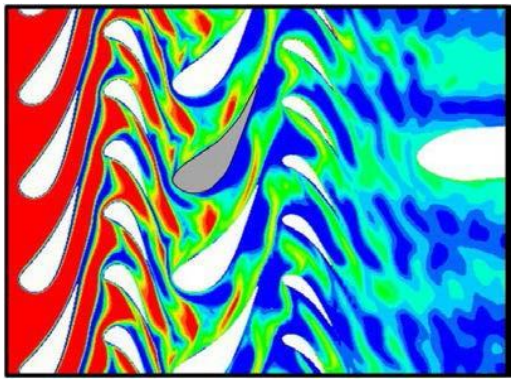
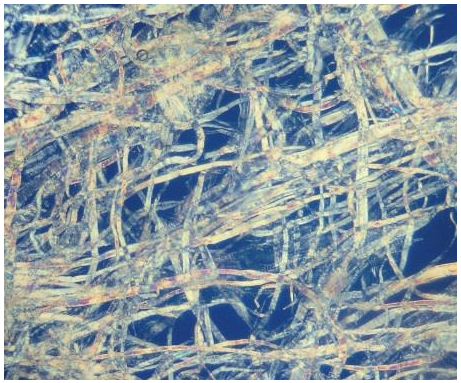
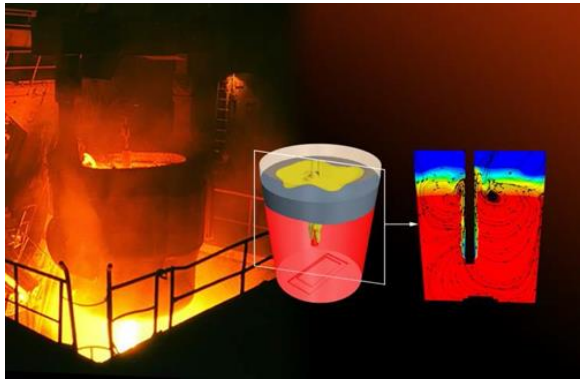
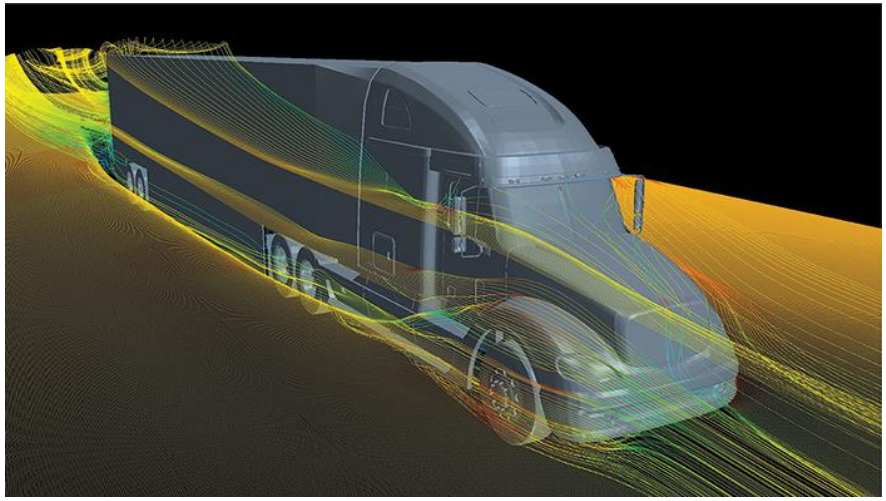
R&D Projects: HPC for Manufacturing

- Program teams manufacturers with DOE's network of National Labs
- Applying High Performance Computing to face critical manufacturing challenges









Lawrence Livermore National Laboratory

BERKELEY LAB
Bringing Science Solutions to the World

OAK RIDGE National Laboratory

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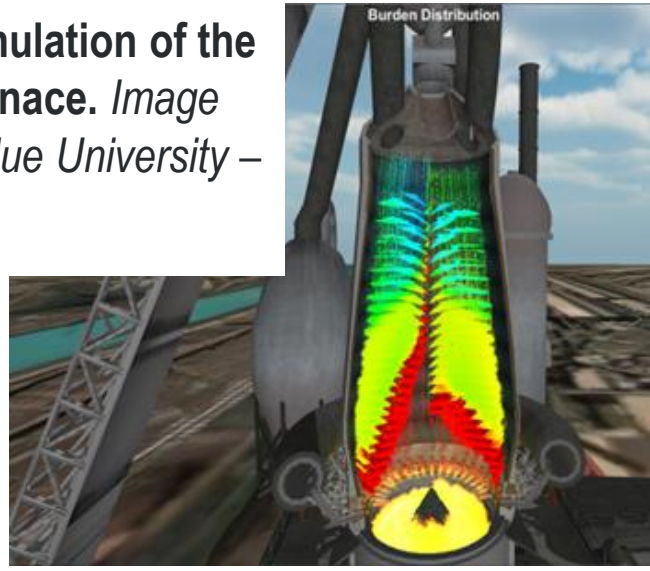
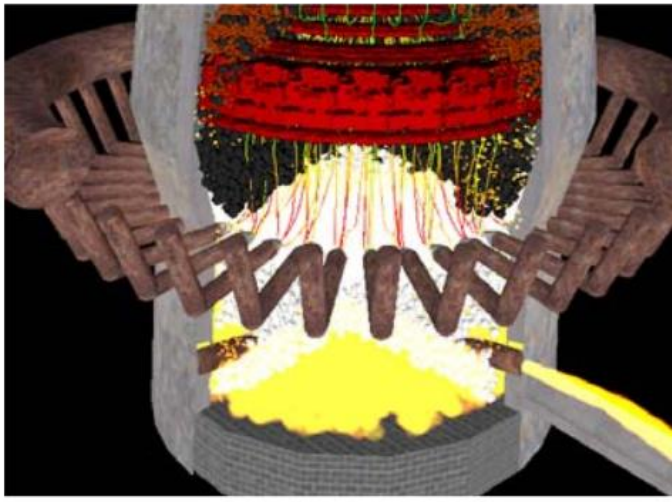
High Performance Computing for Manufacturing

Apply modeling and simulation capabilities to manufacturing challenges

A computer simulation of the virtual blast furnace. *Image courtesy of Purdue University – Calumet.*





- Industry defined challenges
- Businesses Partner with National labs
- Business-friendly terms and streamlined partnering process

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HPC4Mfg leverages global leading HPC capabilities at the national labs to partner with industry and address critical technical challenges in manufacturing

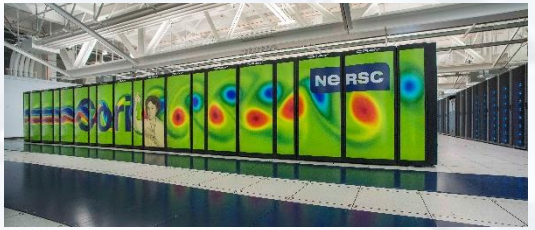
- DOE labs possess 5 of the top 12 HPC systems worldwide and broad expertise in their application: 2 of top 3 in Top500
- Catalyzes Industry / National Lab partnerships

Top500 / November 2016	Rmax (TF/s)
1. Sunway TaihuLight (China)	93,015
2. MilkyWay-2 (China)	33,863
3. Titan (Oak Ridge)	17,590
4. Sequoia (Livermore)	17,173
5. Cori (LBL)	14,015
6. Oakforest – JCAHPC (Japan)	13,555
7. K Computer – Riken (Japan)	10,510
8. Piz Daint - CSCS (Switzerland)	9,779
9. Mira (Argonne)	8,587
10. Trinity (Las Alamos)	8,101

Oak Ridge

Lawrence Livermore

Lawrence Berkeley



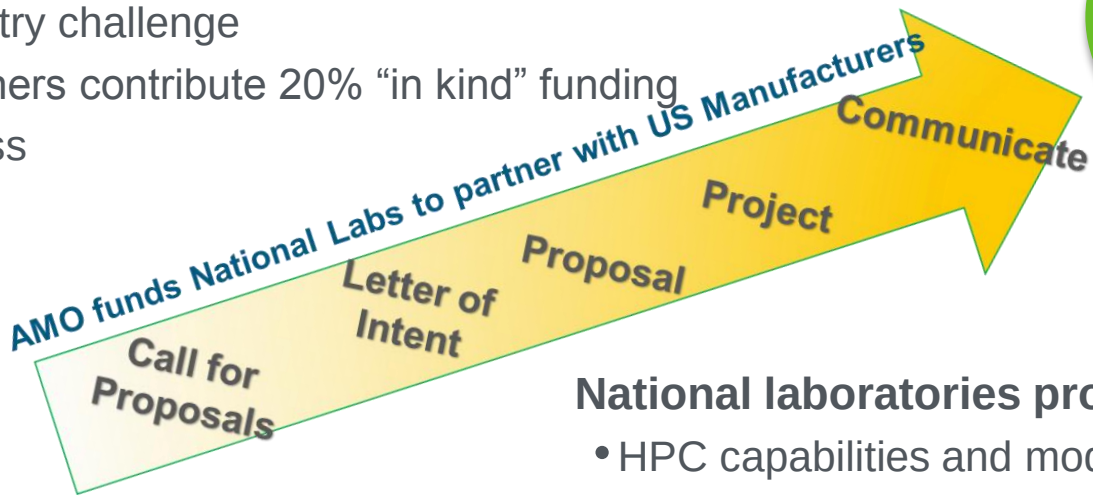
HPC4Mfg Program: Advancing Innovation

Framework:

- Business-friendly terms and streamlined partnering process
- Leverage decades of investment in platforms, codes, and expertise
- Emphasis on open sharing of successes benefits entire sector

U.S. Manufacturers, Industry Partners, and Consortia

- Identify industry challenge
- Industry partners contribute 20% “in kind” funding
- Share success



Increase Energy Efficiency - Advance Clean Energy Technologies

National laboratories provide

- HPC capabilities and modeling/simulation expertise
- Assistance to industry to develop full proposal
- Develop standard CRADA to protect industry IP
- DOE funding < $300K
- Application opportunity every 6 months
- More information at www.hpc4mfg.org

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What does Success Look Like?

Energy Products Invented Here…

…And Competitively Made Here!

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Thank You

Questions?